The Irish Economy and the Environment:

An assessment of its impact and the extent of decoupling

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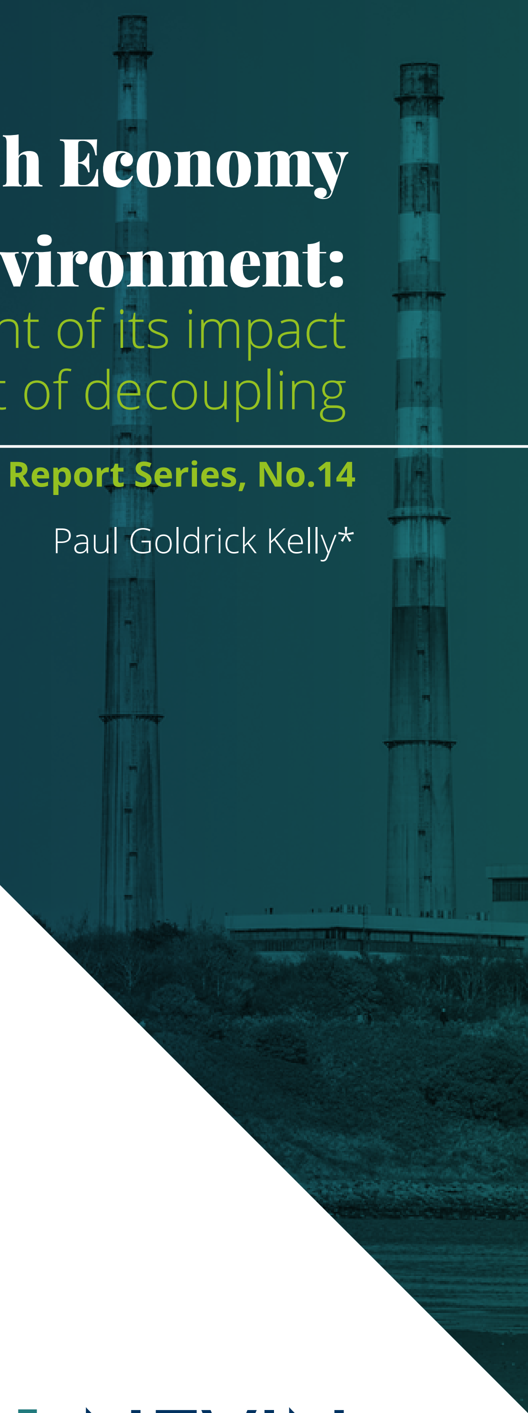

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Introduction

Humanity faces a number of ecological challenges. The link between human produced greenhouse gas emissions and climate change is well known, but it is not the only challenge we face.

As Steffen and colleagues pointed out, human activity had overstepped safe operating limits in several domains by 2015. Apart from climate change, other boundaries referring to biochemical flows from Phosphorus and Nitrogen and Genetic diversity had been transgressed. The former includes things like run off from fertilisers which the planet has limited capacity to absorb, while the latter refers to a highly elevated rate of extinction driven by people. They conclude that we risk destabilising the earth system towards a state that is much less hospitable to human societies.

These processes are driven by exchanges in both directions between economies and the environment. Economies rely on the wider earth system for inputs in the form of materials and energy to enable production and consumption. On the other hand, our activities produce by-products in the form of gas and material emissions into the environment. In both cases, the capacity of the ecosphere to meet these demands is subject to limits. Given our transgression of several boundaries, a reduction in these environmental pressures is necessary if we are to build sustainable economies here and around the world.

This report examines aspects of the Irish economy's interaction with nature. On the input side, material and energy demands are assessed in terms of levels and trends using the Direct Material Inputs (DMI) and Final Energy Consumption indicators.

By-products of activity are measured in the form of Consumption-based CO_2 emissions, overall greenhouse gases, and material flows into the environment from emissions, landfilled waste and dissipative flows.

Since our economy is geared towards economic expansion, and this remains an explicit policy goal, I examine the relationship between economic growth and these indicators. The concept of decoupling refers to a breakage in the historic tendency for inputs and outputs to rise in tandem with economic growth. Relative decoupling refers to a situation where these inputs/outputs grow more slowly than the economy (or fall faster than the economy contracts), leading to an improvement in impact per unit output, or an increase in efficiency.

However, what is required is a fall in overall inputs/outputs. To remain consistent with economic growth, a certain level of absolute decoupling – an absolute contraction in inputs/outputs while the economy expands – is required.

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On the input side, the evidence suggests that Ireland consumes a relatively high amount of input materials and energy compared to EU27 averages, despite declines from pre-crisis peaks apparent in the latest available data. The overall fall in material input use is mainly explained by a decline in non-metallic mineral use, mainly associated with a fall in building activity. The evidence for sustained absolute decoupling is also limited to a few annual cases, and these declines in input use have usually been subsequently offset by growth. Irish data tends to show increases in input productivity – a decline in inputs for each unit output – but these efficiency gains have generally been accompanied by increases in total input use outside of the recession period.

In terms of greenhouse gas emissions, Ireland also produces more than is typical in a European context. Improvements in CO2 emissions have been offset in large part by emissions of other, more potent, greenhouse gases, which make up more of Ireland's emissions profile. There is some evidence of absolute decoupling here however.

Finally, material outputs from the Irish economy are relatively large, with the exception of landfilled materials, which are significantly below the EU average. These landfilled material flows have declined since 2010, showing absolute decoupling, though declines have slowed with economic growth. The other categories: emissions of gases and particulates into the atmosphere, flows into bodies of water, and dissipative flows have increased over time and show no sign of absolute decoupling. The Irish economy is also a relatively poor performer in terms of circularity – the proportion of material inputs coming from recycled sources – ranking 26th of 27 EU states.

To remain consistent with environmental sustainability while exhibiting growth, the Irish economy must engage in absolute decoupling in a more sustained manner, at a much larger scale.

The indicators

An economy's effect on the wider environment can be measured in a variety of ways. For the purposes of this report, the analysis is limited to aggregate indicators describing flows from the environment to the economy and vice versa.

On the input side, the indicators used here refer to aggregate material and energy use. Material use is measured by way of the Direct Material Inputs measure. This measure incorporates all materials extracted from the environment domestically plus imported material by weight. On the energy side, I use final consumption, excluding non-energy uses of materials such as the use of oil for plastic. This is the economy's directly used energy, and as such also excludes energy lost during transformation and distribution.

In terms of outputs, I use two greenhouse gas emissions indicators as well as flows into the environment arising from material use. There is some overlap between these categories. The first indicator refers to so-called "consumption-based" carbon dioxide (CO_2) emissions. This amounts to standard territorial emissions – emissions counted as occurring in the Irish territory – plus emissions from imports minus Irish exports. This is meant to allocate emissions according to where final consumption occurs, rather than by site of production.

While CO2 is the most common greenhouse gas, it is not the only one. Total greenhouse gas emissions measure all gases standardised to their CO_2 equivalent. This is calculated using Global Warming Potential, which measures the heat retention of various gases relative to CO_2. A GWP of two for example implies a single tonne of a gas would be measured as two tonnes of CO_2 equivalent.

Finally, I measure flows into the environment arising from material use. This includes material for landfill, emissions (gases, small particles etc) into the atmosphere or bodies of water and dissipative flows. This final category refers to material which enters the environment through product use, such as the use of fertiliser.

What is decoupling?

Historically, environmental damage has been tightly linked, or coupled, to economic expansion. Environmental decoupling occurs when environmental pressures grow more slowly than the economic activity. This is the same as saying that less environmental pressure is generated by a unit of economic activity.

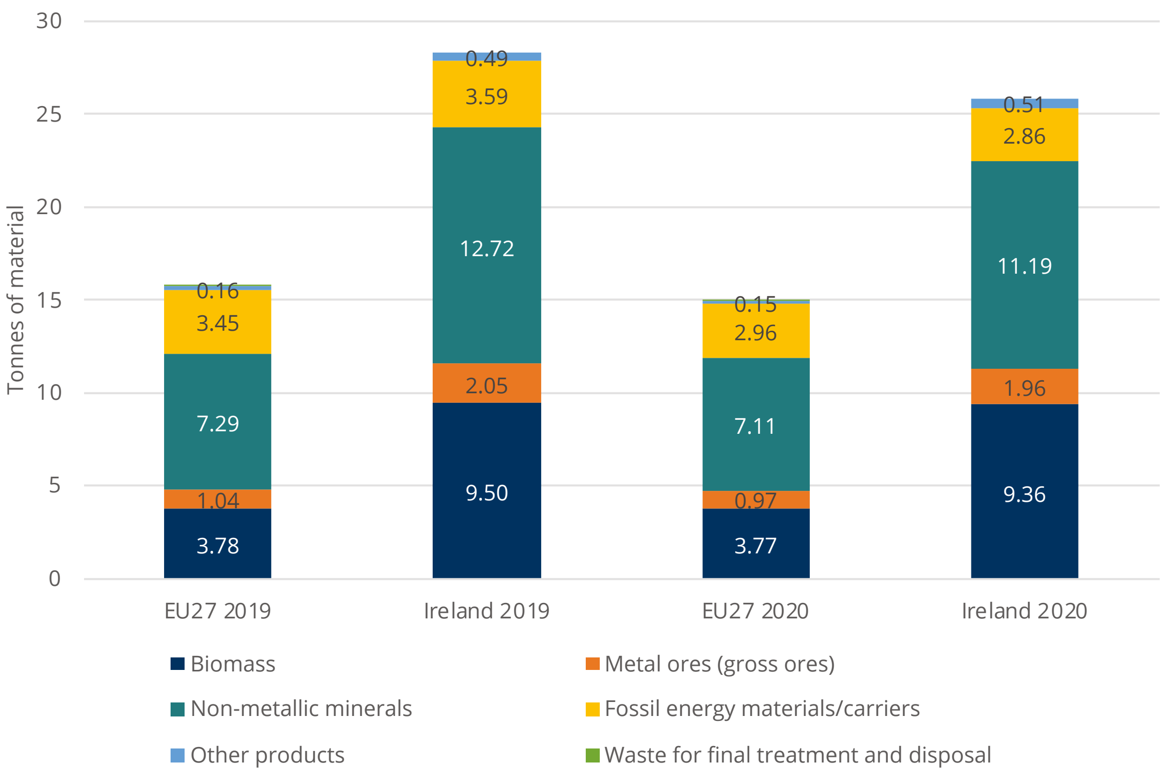
There are two forms of decoupling, relative and absolute. Relative decoupling refers to a situation where ecological impact per unit of economic output falls. This can occur in situations of economic expansion or contraction. Where the economy is growing, this implies resource use is stationary, or growing more slowly than economic output. It can also imply falls in environmental inputs/outputs which outstrip those observed in economic activity.

Absolute decoupling refers to a situation where environmental pressure in aggregate is falling, even as the economy expands. Given the evidence for environmental pressure exceeding planetary boundaries, this form of decoupling will be necessary (and relative decoupling insufficient) if we're to have economic growth while moving to sustainability.

Material/energy use and productivity

Figure 1 demonstrates that material inputs into the Irish economy are significantly higher than the EU27 average on a per person basis at 28.3 and 25.9 tonnes compared to 15.7 and 15.0 tonnes in 2019 and 2020. Aggregate material use per capita was 80 per cent higher than the EU average in 2019, and 73 per cent higher in 2020. The biggest contributors to Ireland's disproportionate material use were the biomass and non-metallic minerals sectors, which accounted for close to nine tenths of the per person difference both years. Biomass use was 2.5 times the EU average both years, and non-metallic mineral consumption about double per person values in both cases.

Figure 1: Direct Material Inputs (DMI) per capita by subcategory



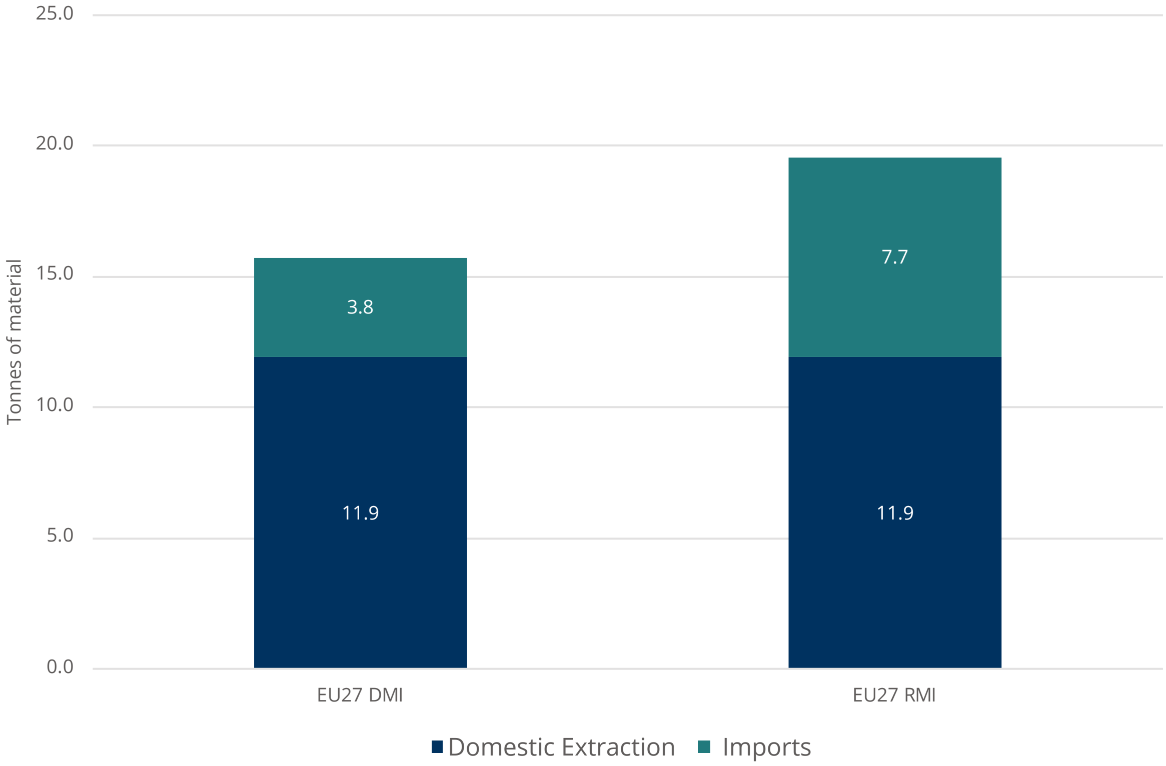
Source: Material flow accounts (Eurostat,2021)

However, it should be noted that DMI indicators tend to underestimate the material impact of imports, since they measure imported materials by unadjusted weight. This understates the material impact of these imports, since these products themselves require material extraction from the environment which exceeds the final weight of the product.

As Figure 2 displays, this difference can be considerable. By unadjusted weight, imported materials amounted to 3.8 tonnes per capita in 2019 in the EU27. Accounting for the material extraction needed to produce these imports effectively doubles their material impact, to 7.7 tonnes per person. Irish data are unavailable, but assuming that imports have the same material extraction impact as is typical for the EU27 leads to an adjusted DMI (known as Raw Material Input) estimate of about 36.9-39.1 tonnes in 2019 and 33.9-36.1 tonnes in 2020 per head in Ireland.[1]

1 The range reflect different adjustment methodologies. Applying the aggregate import adjustment from aggregate imports in the EU27, where raw material adjusted imports are approximately double unadjusted imports results in the lower range estimate. The upper range estimate reflects category specific raw material adjustment ratios for the EU27 and applies them to each category in the Irish data. This reflects the different composition of Irish imports compared to their EU27 counterparts.

Figure 2: Comparison of Direct Material Inputs and Raw Material Inputs per capita EU27 2019



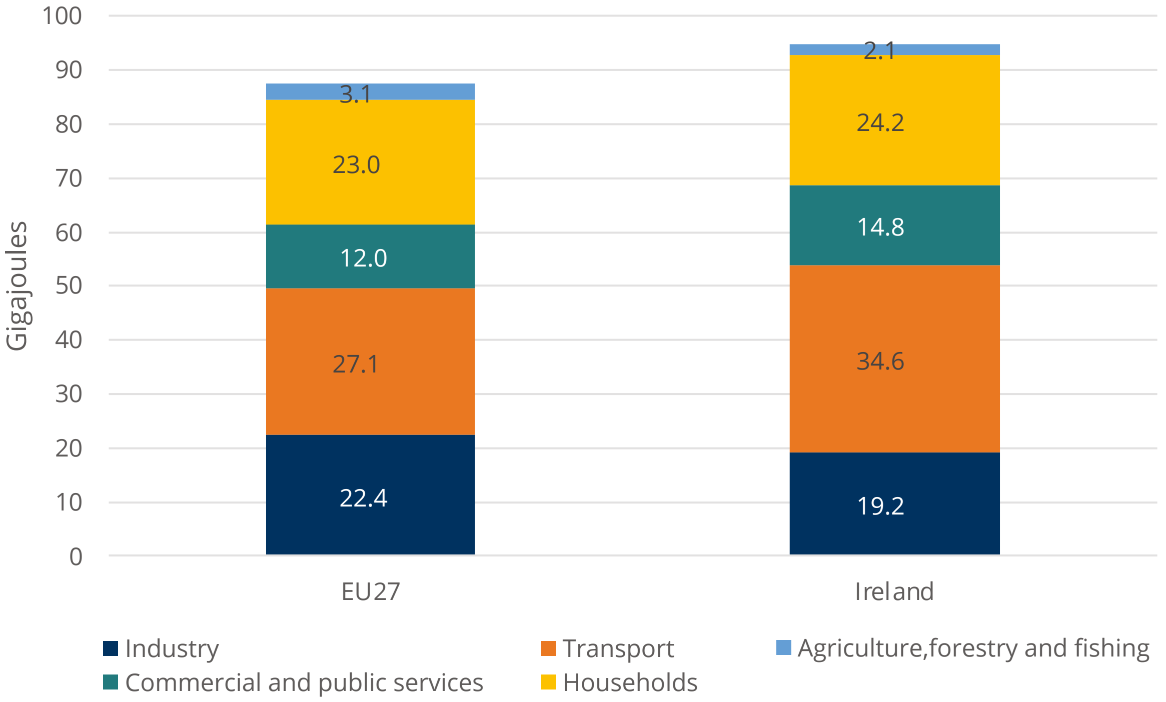
Source: Material flow accounts (Eurostat,2021), Material flow accounts in raw material equivalents - modelling estimates (Eurostat,2021)

Similarly, Figure 3 demonstrates that final energy use in Ireland was significantly above the EU27 average, although the comparative difference is less stark. Irish energy use per person was approximately 8.3 per cent higher than the EU average in 2019, at 94.9 Gigajoules to the EU27 average of 87.6. This is mainly accounted for by higher than average energy use in transport, commercial and public services and the household sector which are 27.7, 23.3 and 5.2 per cent above the EU average respectively. However, final energy consumption in the Industry and agriculture, forestry and fishing sectors was significantly below the EU average, some 14.3 and 32.3 per cent, although in the latter case, the sector is relatively small contributor to overall energy use.

Final energy consumption in the Industry and agriculture, forestry and fishing sectors was significantly below the EU average

The decline in economic output was outstripped by productivity following the economic crash

Figure 3: Final energy use per capita by subcategory 2019



Source: Available energy, energy supply and final energy consumption per capita (Eurostat,2021)

Material and energy efficiency is often targeted as a means to reduce input use from the environment while growing the economy, and is often the focus of policy. This is generally calculated as price adjusted economic output per unit of material/energy input. Table 1 indicates that, despite high aggregate levels of material and energy use, growth in economic output has tended to outstrip both, or conversely, declines in output were not as large as associated declines in both categories.

Between 1995 and 2019, input productivity increased by 57.6 per cent in the case of DMI and 49.2 per cent in the case of final energy use. However, this upward trend was not uniform in both cases. In material terms, following an initial improvement between 1995 and 2000, material productivity declined as the economy expanded. The decline in economic output was outstripped by productivity following the economic crash, resulting in a significant improvement in productivity to 2010, which was continued in the initial recovery period to 2015. Recently economic expansion from 2015 to 2019 was associated with disproportionate increases in material use, leading to a slight fall in measured productivity. Energy productivity on the other hand, tended to show increases as the economy grew, shrinking during the recession period as energy fell more slowly than output.

Table 1 Material and Energy Productivity ROI 1995-2020

Indicator	1995	2000	2005	2010	2015	2019	Δ1995-2019
DMI (kg)	€0.98	€1.01	€0.98	€1.37	€1.57	€1.54	57.6%
Final Energy use	€12.78	€14.03	€14.62	€14.49	€17.20	€19.08	49.2%

Sources: Material flow accounts (Eurostat,2021), Energy flow - Sankey diagram data (Eurostat,2021), Modified Gross National Income at Constant Market Prices (chain linked annually and referenced to year 2019) (CSO,2021)

Changes in material and energy use

An analysis of the composition of material inputs reveals something of the source of Ireland's post crash trend towards higher material productivity. Figure 4 shows a significant upward trend in aggregate DMI between 1995 and 2007, nearly doubling over the period.

Several components of aggregate material increased significantly, but the aggregate trend was driven by rapid increases in non-metallic mineral use which includes materials such as limestone, sand, gravel and fertiliser materials. These materials went from 30.2 million tonnes to 118.9 million tonnes over the same period, a near quadrupling of material throughput.

Figure 4 Composition of Direct Material Inputs ROI 1995-2020

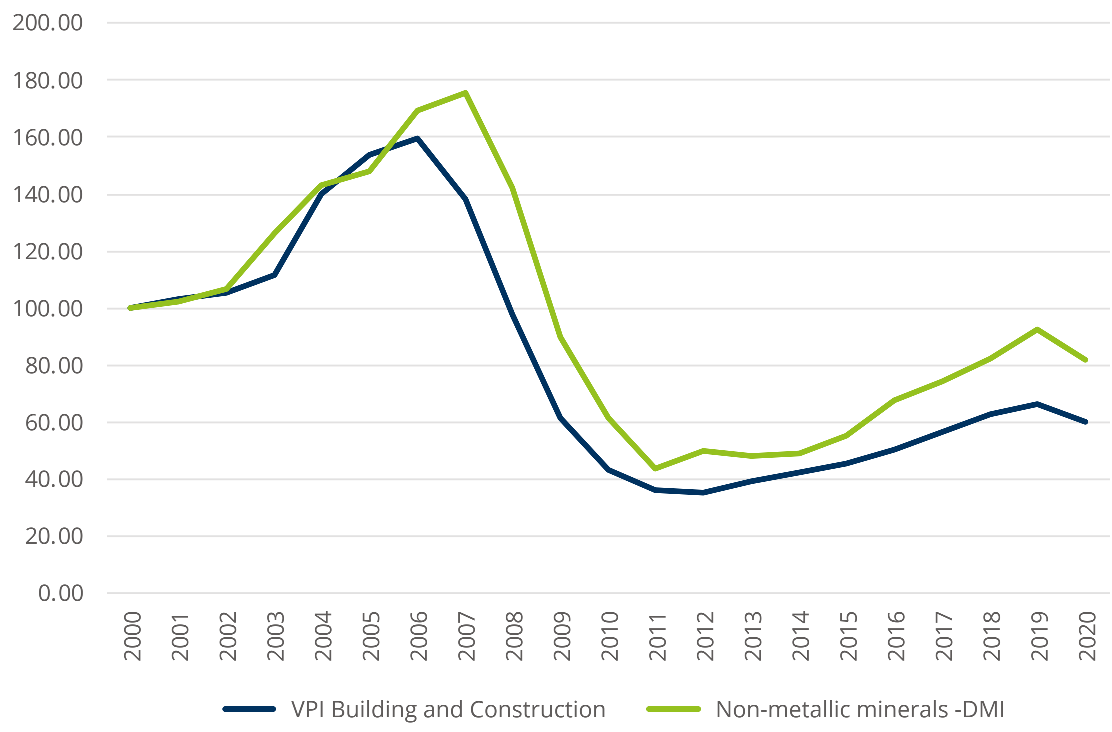
Sources: Material flow accounts (Eurostat,2021)

The period after 2007 to 2011 was characterised by a rapid contraction in material use, with aggregate DMI falling from 194.5 million tonnes to just 104.1 million tonnes, a fall of close to 46.5 per cent. While most categories showed contraction (with the notable exception of Biomass material), declines were again led by non-metallic mineral use. Material use in this category collapsed to less than a quarter of 2007 highs in 2011. At 29.6 million tonnes, material consumption in this category was lower than 1995 levels.

Aggregate inputs have not returned to 2007 levels despite a general growth trend to 2019 (with the exception of 2014). Aggregate consumption was approximately 34.3 per cent higher than 2011 lows in 2019 at 139.9 million tonnes. Again, this was driven by non-metallic mineral use, which accounted for just under 93 per cent of aggregate material use change over the period. 2020 represents the first year since 2014 that aggregate material inputs have declined, falling by some 8.2 per cent or 11.5 million tonnes relative to 2019 values. This was driven by declines in nearly all categories, but predominately non-metallic minerals and fossil energy materials/carriers.

As Figure 5 demonstrates, the primary source of volatility in the series - non-metallic minerals – is closely related to general trends in the construction sector. The general increase in material use pre-crash reflected increases in building and construction measure by the volume of production materials index. Similarly, despite a lag relative to the VPI – which showed the beginning of a decline between 2006 and 2007 – material use closely reflected the rapid decline in production volume in the sector, reaching minimums in 2011/2012. Similarly, the increase in production volume beginning in 2012 shows a close coupling of material use with activity in the sector up to the pre-pandemic period, after which a production decline is reflected in material use data.

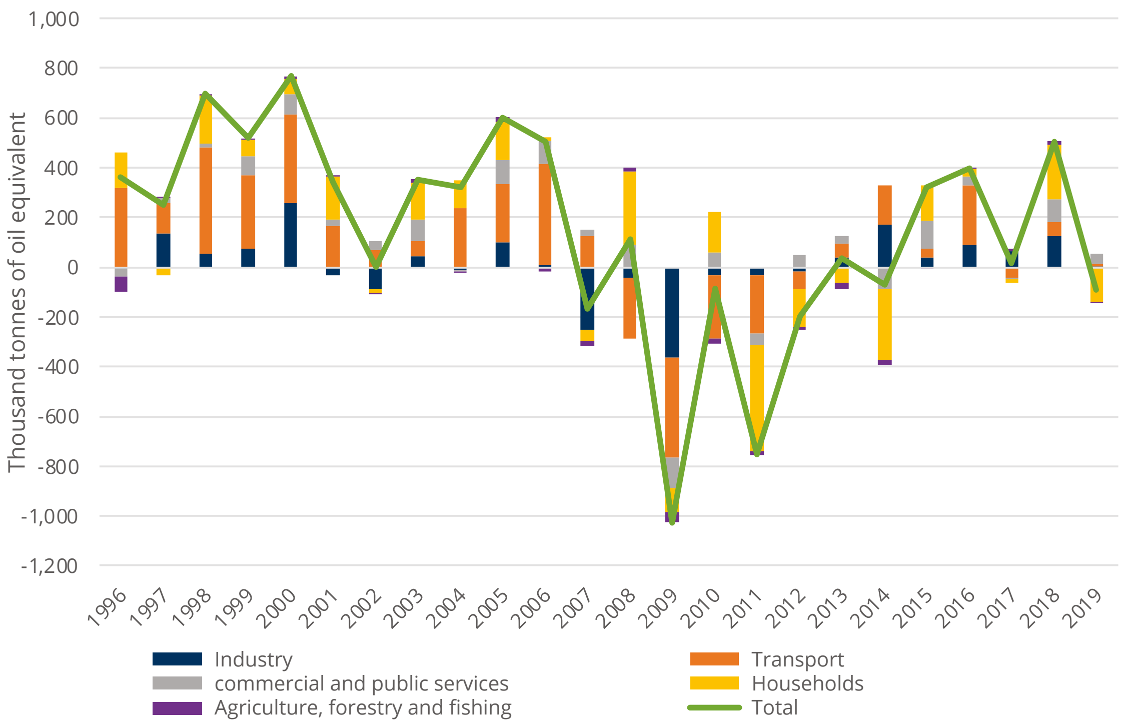
Figure 5: Non-metal materials vs Volume of Production Index in Building and Construction 2000-2020 (2000=100)



Sources: Indices of Total Production in Building and Construction Sector (Base 2015=100) (CSO, 2021); Material flow accounts (Eurostat,2021)

Figure 6 displays annual changes in final energy consumption by category. We can see that, in most cases, the transport sector was the primary driver of additional energy use, particularly in the 10 years following 2006. The transport sector was also the biggest single contributor to the fall in final energy consumption in 2009, falling by 399.1 thousand tonnes of oil equivalent. However, the industry, commercial and public services and household sectors also showed significant falls of 364, 124 and 96 thousand tonnes of oil equivalent respectively. Energy use in transport continued to fall between 2010 and 2012, though in 2011 and 2012 declines in household energy use were the biggest contributor to overall declines. Since 2015, energy use has increased, with the exception of 2019. The latter decrease was driven by declines in household energy use.

Figure 6: Changes in final energy use by sector



Source: Energy flow - Sankey diagram data (Eurostat,2021)

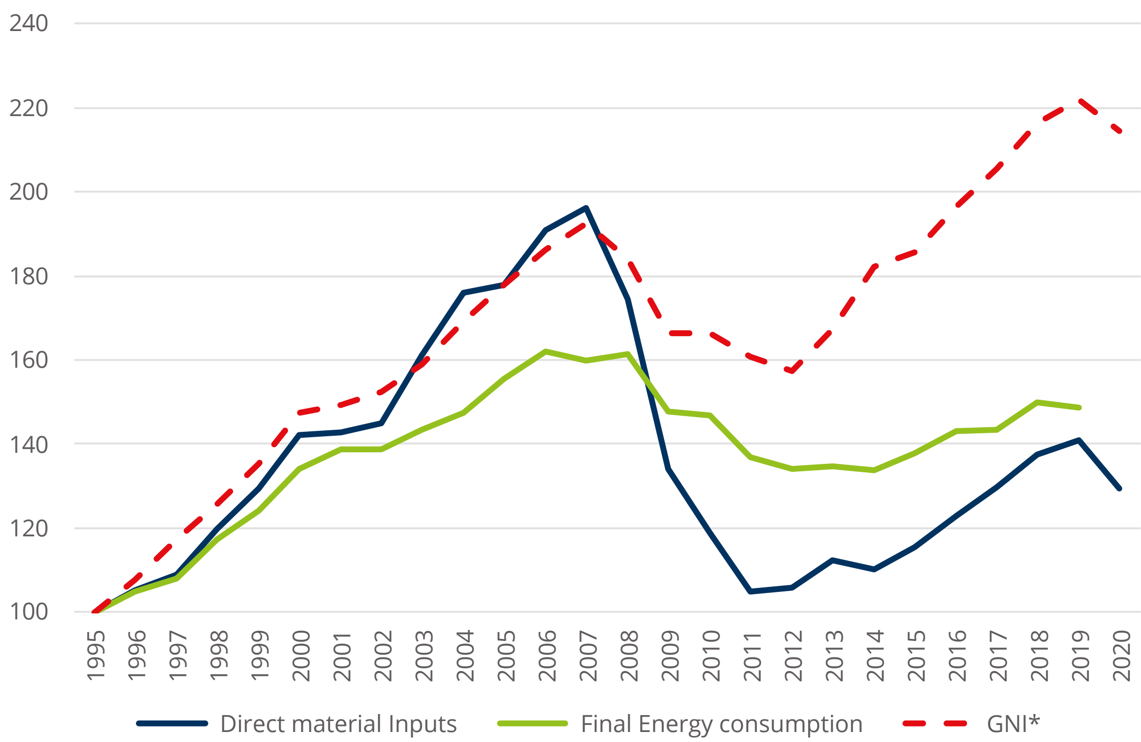
Note: For reference, Irish final energy use was 7.6 million tonnes of oil equivalent in 1995, 12.3 million tonnes at its peak in 2006 and 11.3 million tonnes in 2019.

Evidence for material/energy input decoupling

As outlined in the introduction, economic growth will only be consistent with ecological sustainability if material inputs and outputs into and out of the economy break their historic association or coupling. To achieve absolute decoupling, material/ energy inputs must decline as the economy continues to expand.

Figure 7 displays the material and energy use, as well as output measured in adjusted gross national income (GNI*) scaled to their 1995 values. We can see that output as measured by GNI* more than doubled between 1995 and 2020, despite a dip from peak levels in 2019 caused by the pandemic. At the same time, energy and material consumption were between 48.8 and 40.9 per cent above their 1995 values in 2019.

Figure 7 Trend in material and energy use relative to output growth ROI 1995-2020 (1995=100)



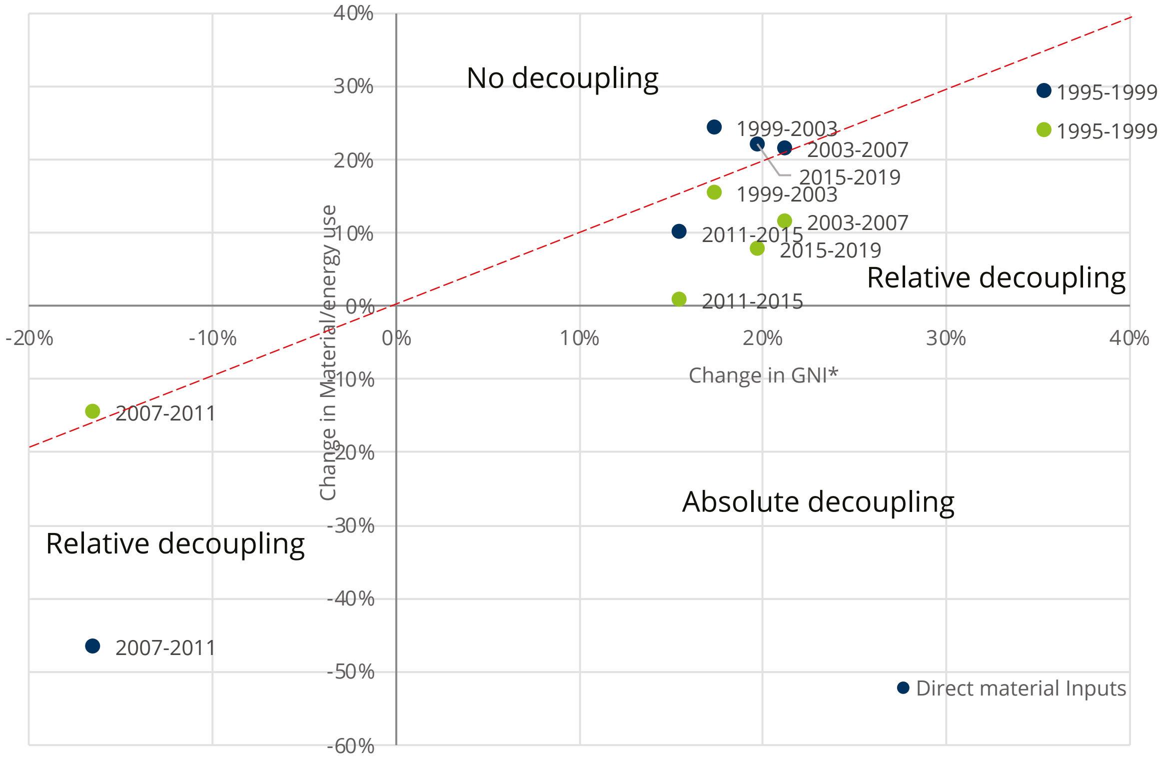
Sources: Material flow accounts (Eurostat,2021), Energy flow - Sankey diagram data (Eurostat,2021), Modified Gross National Income at Constant Market Prices (chain linked annually and referenced to year 2019) (CSO,2021)

Figure 8 shows growth rates for inputs and the economy at large for several periods between 1995 and 2019. The dashed line represents coupling: on or above the line, material/energy inputs have grown as or more quickly than the economy. Below that line, in the top right quadrant, material/energy inputs are still rising, but less quickly than economic growth. The bottom right quadrant represents a situation of absolute decoupling ,characterised by reductions in input use while the economy grows. Figure 7 shows that growth from 1999 to 2007, and the most recent period between 2015 and 2019, has been characterised by a coupling with material use. The growth periods of the late 90s, and the immediate post crash recovery period from 2011 to 2015 show some relative decoupling. The crisis period of 2007-2011 also shows some relative decoupling, since material input use fell faster than GNI*. This is less prevalent where energy consumption is concerned, which has mostly been characterised by relative decoupling with output growth. The exception in energy consumption is the contraction period following 2007, where economic output fell faster than energy use.

Breaking the data down into annual changes shows a similar picture. Absolute decoupling is only apparent in a single year case where direct material inputs are concerned, falling by 1.9 per cent in 2014 when GNI grew by 8.9 per cent in real terms. Concerningly, most of the growth period following 2014 was accompanied by a recoupling with economic output, as material use growth grew faster than output between 2015 and 2018, before reverting to relative decoupling in 2019, where material use grew by 2.5 per cent while the economy expanded by 2.6 per cent. The recent pandemic contraction disproportionately impacted material use, which declined by 8.2 per cent, compared to a fall of 3.5 per cent in economic activity.

Final energy demand has also tended to show coupling or relative decoupling on an annualised bases, but has more frequently seen examples of absolute decoupling with economic growth in 2002, 2007, 2014 and 2019. These absolute declines in energy use with economic growth have tended to be relatively small however, never exceeding drops of 1.4 per cent. They have also tended to be overwhelmed by subsequent growth in energy use which offset these year on year declines.

Figure 8 Change in Material/energy use vs Change in GNI* 1996-2020



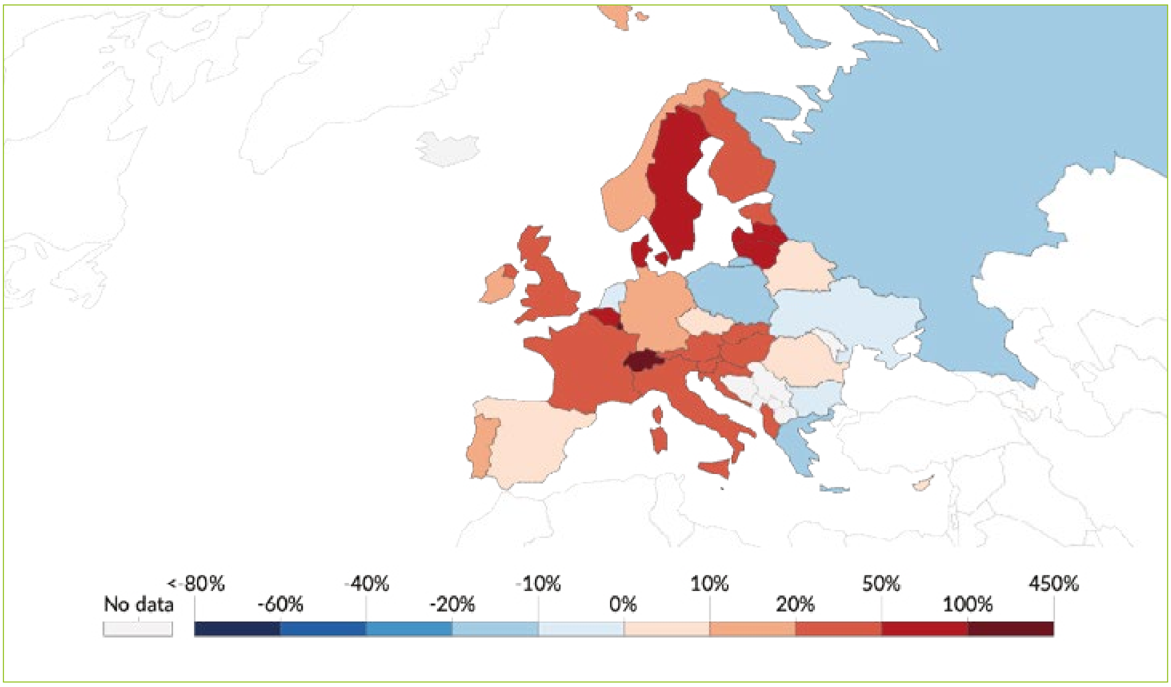
Sources: Material flow accounts (Eurostat,2021), Energy flow - Sankey diagram data (Eurostat,2021), Modified Gross National Income at Constant Market Prices (chain linked annually and referenced to year 2019) (CSO,2021)

Outputs into the environment from production and consumption

Greenhouse gas emissions

Figure 9 and 10 display measures associated with consumption-based CO_2 emissions. These consumption data are divided into territorial emissions, and emissions transfers. The latter category refers to net emissions from trade, excluding those associated with exports while adding those tied to imports. Figure 8 displays these net emissions from trade as a proportion of emissions measured on a territorial basis. Shades of red indicate states that are net importers of emissions, that is, emissions from consumption are larger than territorial emissions, while shades of blue indicate the opposite. We can see that Ireland, like most European states, and like the EU-27 as a whole, is a net importer of emissions. These additional emissions from trade were about 10.6 per cent the size of territorial emissions in 2019. While significant, it should be noted that a number of EU states, as well as the EU27 as a whole, display relatively larger net emissions imports. The net imported emissions from trade were 18.4 per cent the size of territorially counted emissions in 2019, and some leading territorial emissions performers such as Sweden, the UK and France showed relatively large net emissions imports at 65.8, 38.5 and 33.6 per cent respectively in 2019.

Figure 9: Carbon Dioxide emissions from trade as a proportion of domestic emissions 2019

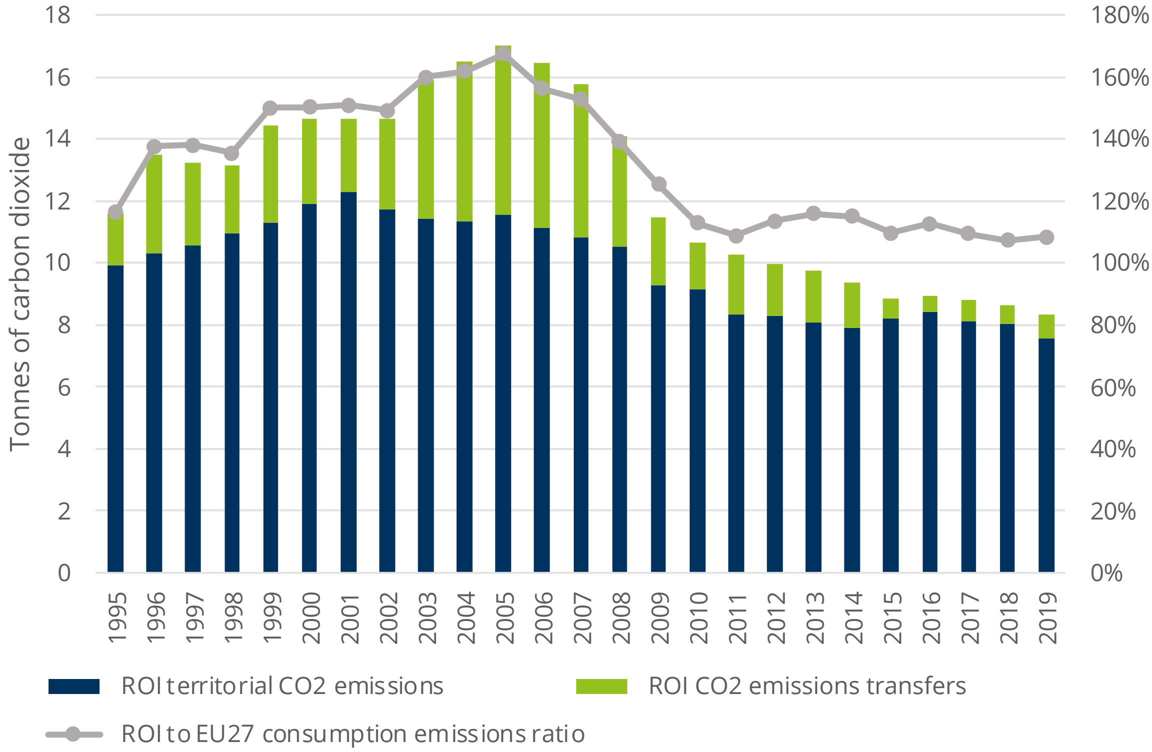


Source: Our World in data CO2 emissions (2021)

However, despite the fact that a relatively small proportion of consumption CO_2 emissions were accounted for by net imports, Irish CO_2 emissions were relatively high measured on a per person basis as Figure 10 displays.

Despite some convergence between per capita CO_2 consumption emissions in Ireland and the EU27 – where Irish emissions were as much as 65.5 per cent higher than the EU average pre-crash – Irish consumption emissions are significantly above average. In 2019, Irish CO_2 emissions were 8.4 per cent higher than was typical for the EU27, at 8.4 tonnes per head. This represents a significant decline from a peak in 2005 of just over 17 tonnes. Despite a tendency towards decline in CO_2 emissions measured on a territorial basis (the blue bars), the most dramatic falls came from imported CO_2. Imported CO_2 per capita fell by over 85 per cent from its peak in 2005 to the latest available data in 2019, from 5.4 tonnes to 0.8 tonnes.

Figure 10 Consumption-based carbon dioxide emissions per capita in Ireland



Sources: National carbon emissions 2021 (Global Carbon Project, 2021) updated from Peters et al. 2011

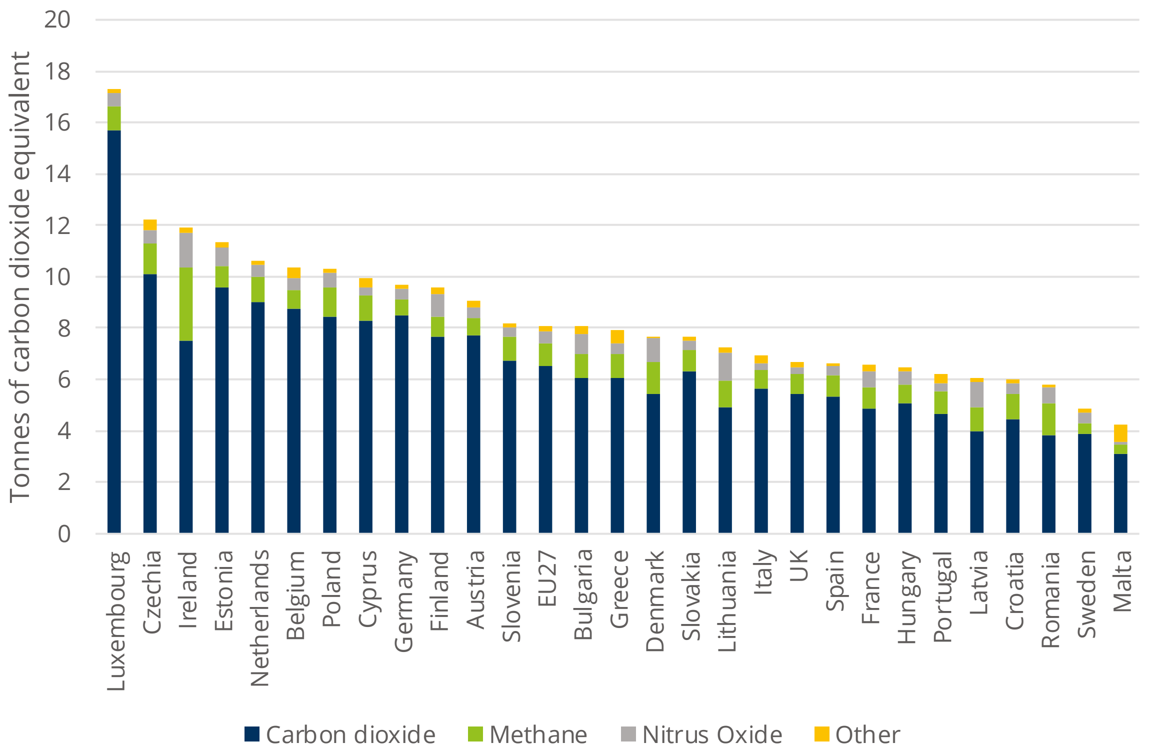
Despite some progress in CO_2 emissions reductions, Irish greenhouse gas emissions are disproportionately accounted for by other gases, particularly methane, which retain more heat in the atmosphere.

Figure 11 shows total greenhouse gases (GHGs) per head in 2019.[2] Counting all emissions on a common basis shows Irish per capita emissions were 47.2 per cent

2 These greenhouse gases are measured using territorial accounting, rather than a consumption based measure as total consumption based greenhouse gas data are unavailable.

above the EU27 average, or 3rd among current and former EU members in 2019. Approximately one tonne of the 3.8 tonne gap was attributable to differences in CO_2 emissions, but just under two tonnes of the gap came from excess methane emissions in Ireland. This is particularly notable since Irish methane emissions are more than 3.3 times higher than the EU average. Ireland also emitted nearly 2.8 times more nitrous oxide, a potent greenhouse gas, on a per person than was typical for the EU27 in 2019.

Figure 11 Total Greenhouse gas emissions per capita 2019



Source: Air emissions accounts totals bridging to emission inventory totals (Eurostat, 2021)

Table 2 displays sectoral contributions to GHGs from 1995 onward. Overall, emissions have decline slightly from their levels in 1995, mostly driven by changes in the Energy Industries sector – comprised mainly of electricity and heat generation – which fell by more than a third. More concerningly, emissions from major contributing sectors such as Transport, the residential sector and Agriculture, grew between 1995 and 2020. Despite a fall in Transport emissions between 2019 and 2020 of 1,916 thousand tonnes of CO2 equivalent, the sector emitted 4,024 thousand more tonnes in 2020 compared to 1995 values. This annual fall also offsets increases in emissions as the economy grew significantly after 2015.

The biggest single contributor to overall greenhouse gas emissions, Agriculture, added an additional 398 thousand additional tonnes of emissions between 1995 and 2020, despite significant falls in emissions between 2000 and 2010. Agricultural emissions have been the most significant recent impediment to greenhouse gas reductions in the most recent five-year period, growing by 1.4 million tonnes between 2015 and 2020.

Table 2 Sectoral greenhouse emissions changes

Emissions sector	Changes in thousand tonnes of CO_2 equivalent					2020 value as % of 1995 value	Contribution to 2020 emissions
	1995-2000	2000-05	2005-10	2010-15	2015-20		
Energy Industries	2,720.5	-297.6	-2,433.6	-1,526.9	-3,255.8	64.4%	15.0%
Residential	480.3	1,154.4	572.7	-2,264.9	612.8	108.5%	12.3%
Manufacturing Combustion	1,148.5	-8.1	-1,323.1	121.5	250.1	104.4%	7.8%
Commercial Services	-43.2	-8.5	-201.6	45.3	82.3	88.2%	1.6%
Public Services	-17.8	-36.4	12.3	-33.3	28.9	95.1%	1.6%
Transport	4,522.0	2,345.7	-1,602.6	288.3	-1,529.3	164.1%	17.9%
Industrial Processes	798.5	-1,023.9	-1,298.8	544.1	100.8	70.6%	3.7%
F-Gases	542.3	430.0	-70.6	102.1	-444.6	347.1%	1.4%
Agriculture	-97.0	-547.4	-1,211.5	811.7	1,441.9	101.9%	37.1%
Waste	-336.4	-200.8	-760.6	424.6	-49.2	49.6%	1.6%
Total	**9,717.8**	**1,807.5**	**-8,317.5**	**-1,487.4**	**-2,762.3**	**98.2%**	100.0%

Source: Ireland's Provisional Greenhouse Gas emissions 1990-2020 (EPA, 2021)

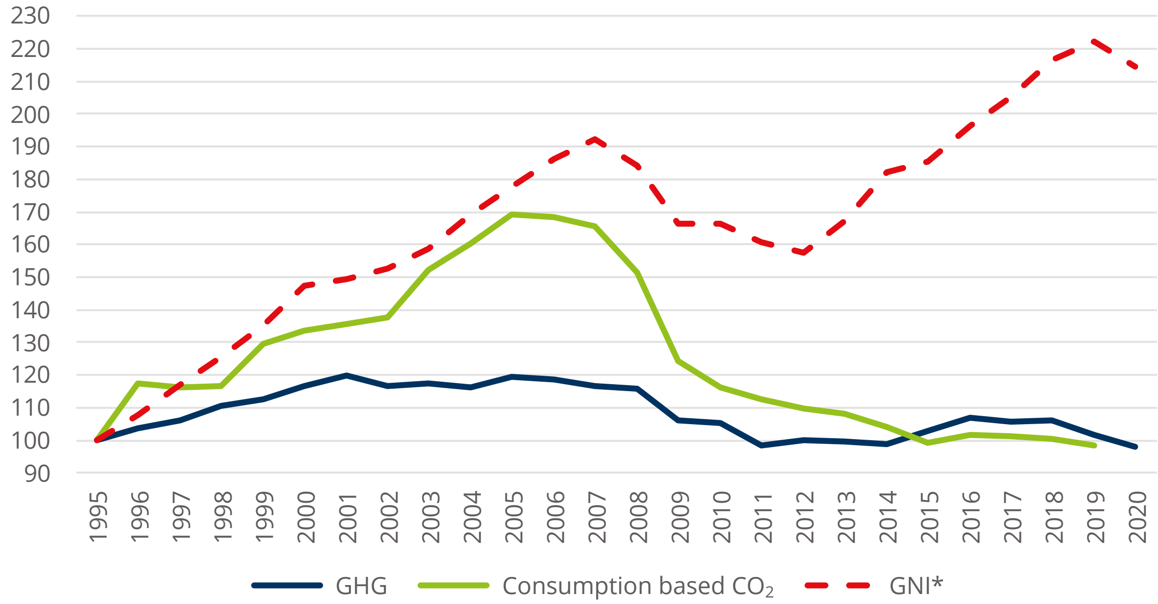
Evidence for emissions decoupling

Figure 12 shows relative trends in consumption-based CO_2 and greenhouse gas emissions, alongside the trend in output measured by GNI* between 1995 and 2020. We can see that while emissions rose between 1995 and the pre-crash period, 2020 data imply a reversion to approximately 1995 levels, showing a decline of approximately 1.8 per cent to 2020 for GHGs and 1.4 per cent to 2019 for consumption-based CO_2.

In the meantime, output has more than doubled. This indicates that output has become more emissions efficient, that is, each unit of output is associated with less emissions in the latest available data than it was in 1995, and has shown slight absolute decoupling over the period.

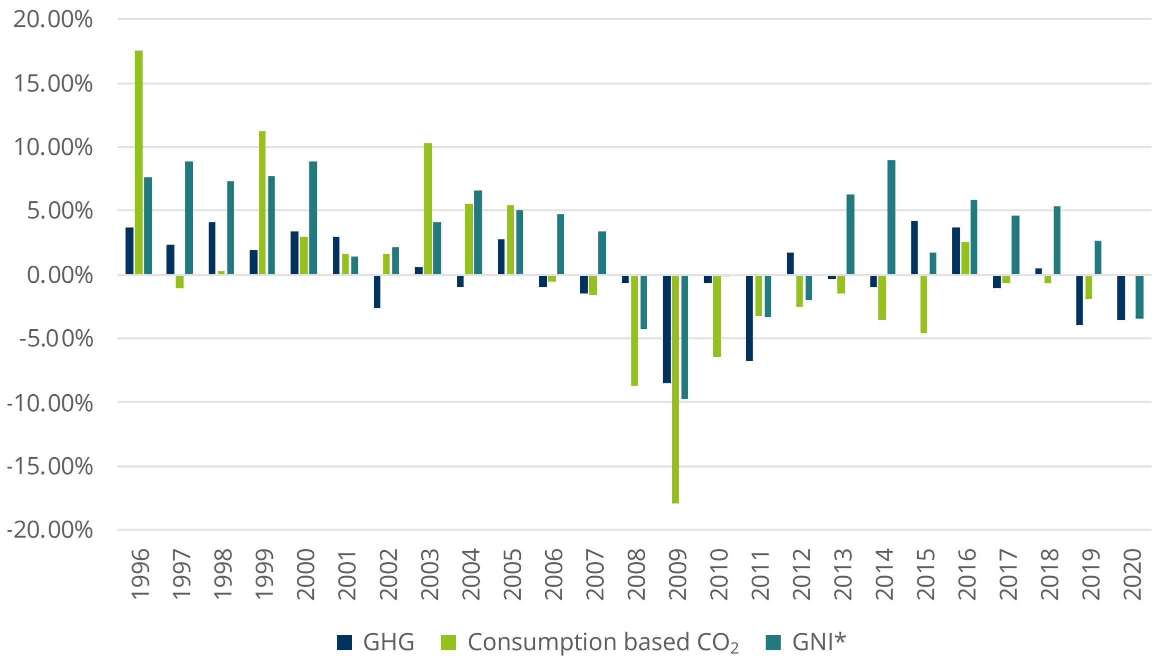
Figure 13 shows changes presented on an annualised basis. We can see that the precrash period showed instances of absolute decoupling, in 2002, 2004, 2006 and 2007 in the case of GHGs and 1997, 2006 and 2007 in the case of consumption-based CO_2 emissions. In both cases, this was insufficient to offset emissions increases over the period. The most significant sustained falls occurred with the crisis period of 2008-2011/12, peaking in 2009. In these cases, emissions tended to fall more quickly than output. The recovery period following 2012 has been characterised by more sustained aggregate decoupling, despite emissions increases in 2015, 2016 and 2018 for GHGs and 2016 for consumption-based CO_2.

Figure 12 Emissions to output trend (1995=100)



Source: Ireland's Provisional Greenhouse Gas emissions 1990-2020 (EPA, 2021), National carbon emissions 2021 (Global Carbon Project, 2021) updated from [Peters et al. 2011](), Modified Gross National Income at Constant Market Prices (chain linked annually and referenced to year 2019) (CSO,2021)

Figure 13 Annual changes to emissions and output

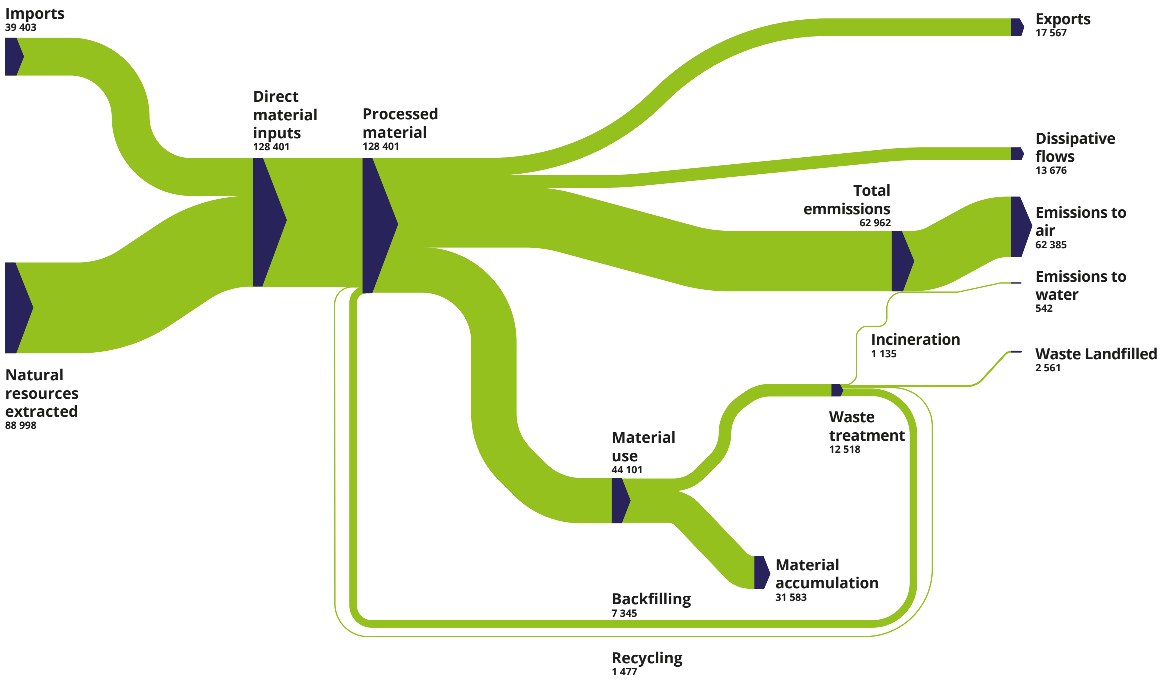


Source: Ireland's Provisional Greenhouse Gas emissions 1990-2020 (EPA, 2021), National carbon emissions 2021 (Global Carbon Project, 2021) updated from Peters et al. 2011, Modified Gross National Income at Constant Market Prices (chain linked annually and referenced to year 2019) (CSO,2021)

Material flows into the environment

The material inputs referred to in the opening section of this report must either remain in the economy as accumulated and backfilled/recycled material or leave it as exports or flows into the environment. Figure 14 is a Sankey flow diagram illustrating this process.

Figure 14 Sankey material flow diagram (thousands of tonnes) Ireland 2020



Source: Material flow diagram for Ireland 2020 (Eurostat, 2021)

Flows into the environment are significant, with 62.4 million tonnes of emissions in the form of gases and particulates flowing into the environment in 2020. A further 542,000 tonnes entered various bodies of water and 2.6 million tonnes were landfilled that year.13.7 million tonnes of materials entered the environment as dissipative flows.

Table 3 offers a per person comparison of these flows to the EU27 average in 2020. Despite the drop in material inputs in 2020, Irish emissions and dissipative flows per capita were well above EU averages. Emissions to water and dissipative flows into the environment were around 6.5 and 5.4 times the EU average at 108.7 kg and 2,743.1 kg respectively per head. Landfilled waste was significantly below the EU average, at just over a third of EU27 average levels.

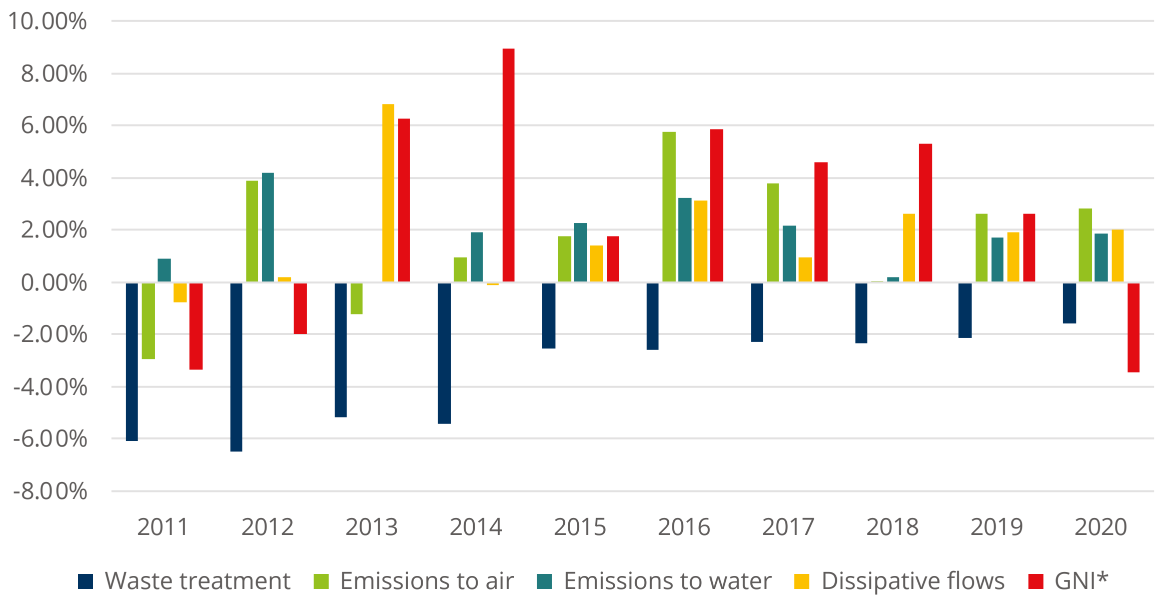
Table 3 Material flows into the environment per capita in kilograms 2020

Flow type	Ireland	EU27
Waste treatment	513.7	1,522.3
Emissions to air	12,512.9	5,570.5
Emissions to water	108.7	16.6
Dissipative flows	2,743.1	512.5

Source: Material flows for circular economy - Sankey diagram data (Eurostat,2021), Management of waste by waste management operations and type of material - Sankey diagram data (Eurostat, 2021), Author calculations Note: Waste treatment excludes backfilled and recycled material, to reflect material flows into the environment. This amounts to the sum of landfilled waste and emissions associated with incineration.

Figure 15 shows annual changes in flows into the environment arising from material use from 2011 onwards. Landfilled waste has steadily declined since 2010, falling every year to 2020, although these declines have slowed. This includes the growth period from 2013 to 2019, implying an absolute decoupling of this environmental pressure from output. Emissions into the atmosphere and water systems have tended to increase over time however, even during the final 2019 to 2020 period where the economy as a whole contracted, although this was outpaced by growth for the most part implying a decline in the emissions intensity of output even as emissions rose in aggregate. Similarly, dissipative flows show no evidence of absolute decoupling with the exception of 2014, when these flows fell slightly in aggregate even as growth proved slower than that for GNI*.

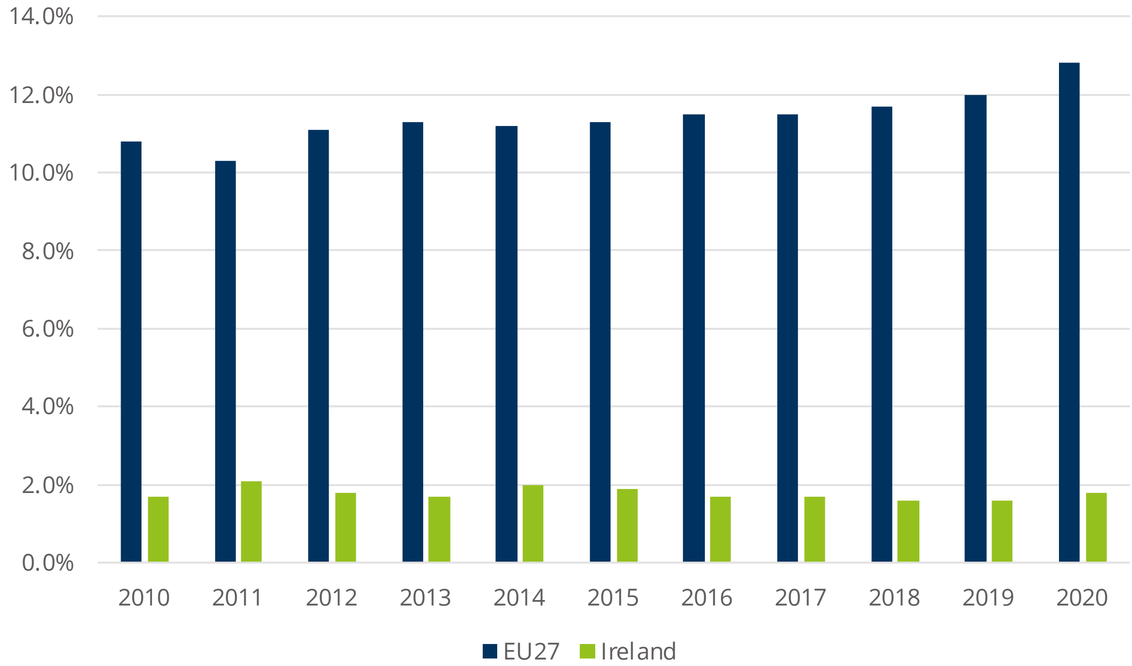
Figure 15 Annual changes to flows into environment and output



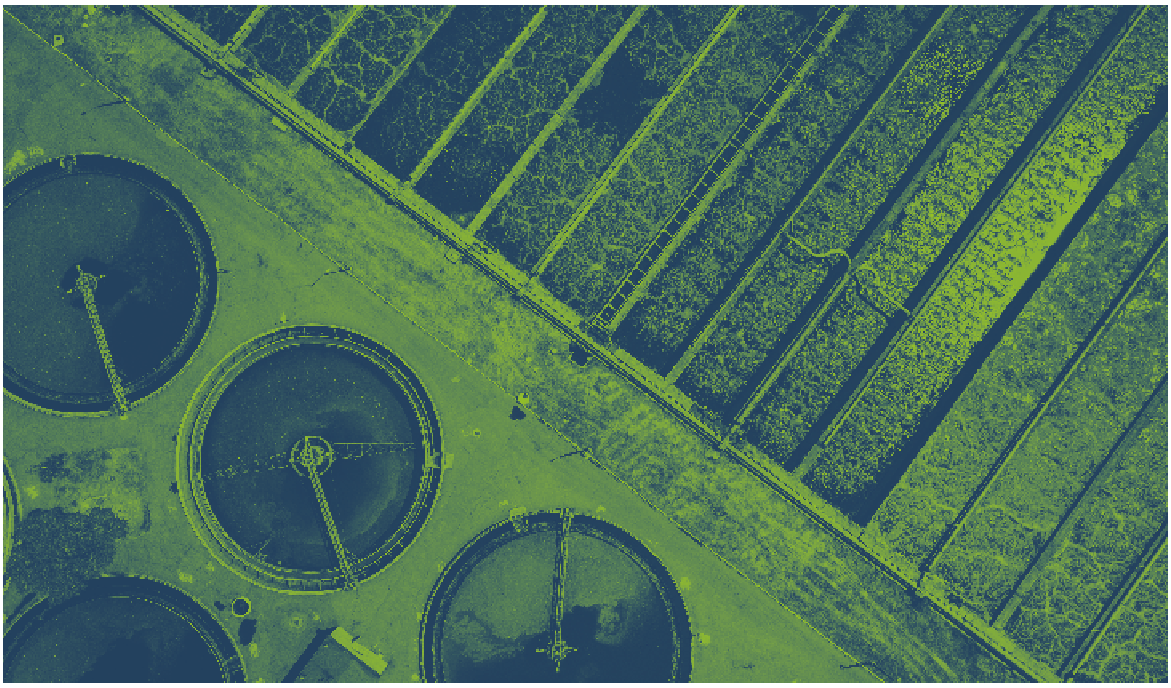
Source: Material flows for circular economy - Sankey diagram data (Eurostat,2021), Management of waste by waste management operations and type of material - Sankey diagram data (Eurostat, 2021), Modified Gross National Income at Constant Market Prices (chain linked annually and referenced to year 2019) (CSO,2021)

Finally, Figure 16 displays the circularity rate, that is, the proportion of materials fed into the economy that come from recycled materials over time. Ireland is persistently among the EU's poorest performers in these terms, ranking 26th of 27 EU states in 2020. The gap between Ireland and the EU27 has tended to grow over time, representing just a one seventh of the EU average in 2020. A trend towards a positive coupling – that is an increase in an environmental good like recycling as a proportion of aggregate material use – is not apparent in the Irish data.

Figure 16 Circularity rate



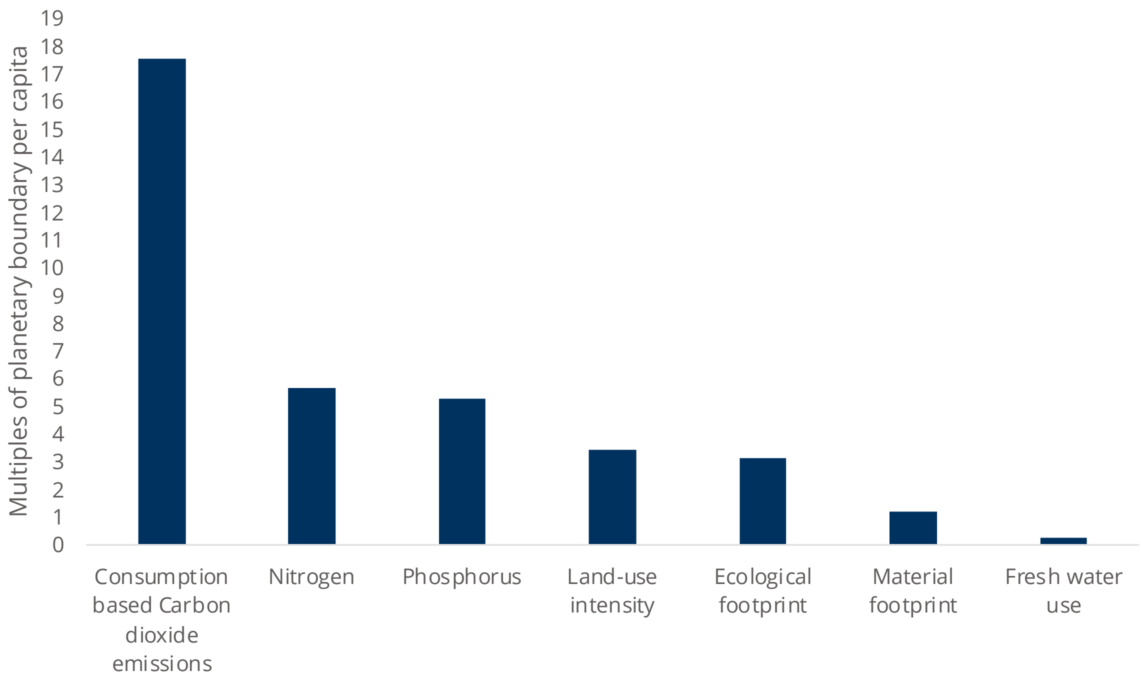
Source: Circular material use rate (Eurostat,2021)



Conclusion

The foregoing implies that absolute decoupling has been rare and insufficiently sustained where it has occurred, on both the input and output side. As Figure 17 indicates, this is concerning given Ireland's significant overstepping of planetary boundaries in six of seven measure domains.

Figure 17 ROI per capita consumption relative to respective boundary (=1)



Source: Does consumption in the Republic of Ireland respect planetary boundaries? (Goldrick-Kelly,2021)

Policy must focus on bringing Ireland's environmental footprint down to safe operating levels in multiple domains, including but not limited to emissions associated with climate change. However, these changes must take differences in ecological impacts across the population into account, including between differing social and economic classes. Policy efforts including universal basic services could provide the useful effects needed without the same environmental footprint as individualised consumption.

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